"Interface Circuits and Systems for Inertial Sensors"

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MEMS inertial sensing technology is employed in a wide array of applications including automotive, industrial, and consumer electronics. In particular, MEMS gyroscopes and accelerometers have been successfully embedded into mobile handsets, personal navigation units, and tablet computers to provide motion sensing functionality. In recent years, efforts have been made to improve the performance of MEMS inertial sensors to navigation-grade, requiring the circuit interface architectures to provide high dynamic range, low noise, and bias and scale factor calibration functionalities.

In this tutorial, fundamentals of MEMS inertial sensor interface circuits are discussed, and a review of the current state-of-the-art will be presented, with emphasis on gyroscope readout and control systems. Details of circuit building blocks, and system-level design considerations and challenges will be explored in the context of conventional coherent AM demodulation architecture, followed by a review of the most recent frequency and phase demodulation methods for angular rate measurement, and electrostatic self-calibration. Lastly, different methods of automatic mode-matching and quadrature compensation in high-performance gyroscope interface systems will be discussed.

Arashk Norouzpour-Shirazi received his BS and MS degrees in 2005 and 2008 respectively, in electrical and computer engineering, from the University of Tehran, Iran. His research was mostly focused on high-speed analog-to-digital converter circuits. In 2009, he started the PhD program at Georgia Institute of Technology, school of ECE, where he joined Integrated MEMS laboratory in 2010. Mr. Shirazi is currently working towards the PhD degree, focusing on analog and mixed-signal circuits and systems for control and calibration of MEMS gyroscopes.